

**Office of  
Science**

*U.S. Department of Energy*

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# **Utilizing the DOE National Laboratory Complex to Develop and Evaluate Technologies and Systems to Reduce Carbon Intensity**

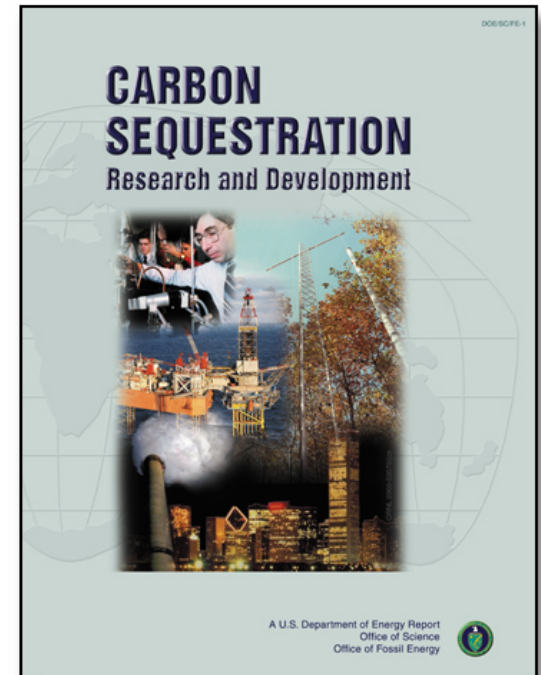
**Dr. Raymond L. Orbach**  
**Director**

**Second Annual Conference on Carbon Sequestration**  
**Hilton Alexandria • May 8, 2003**

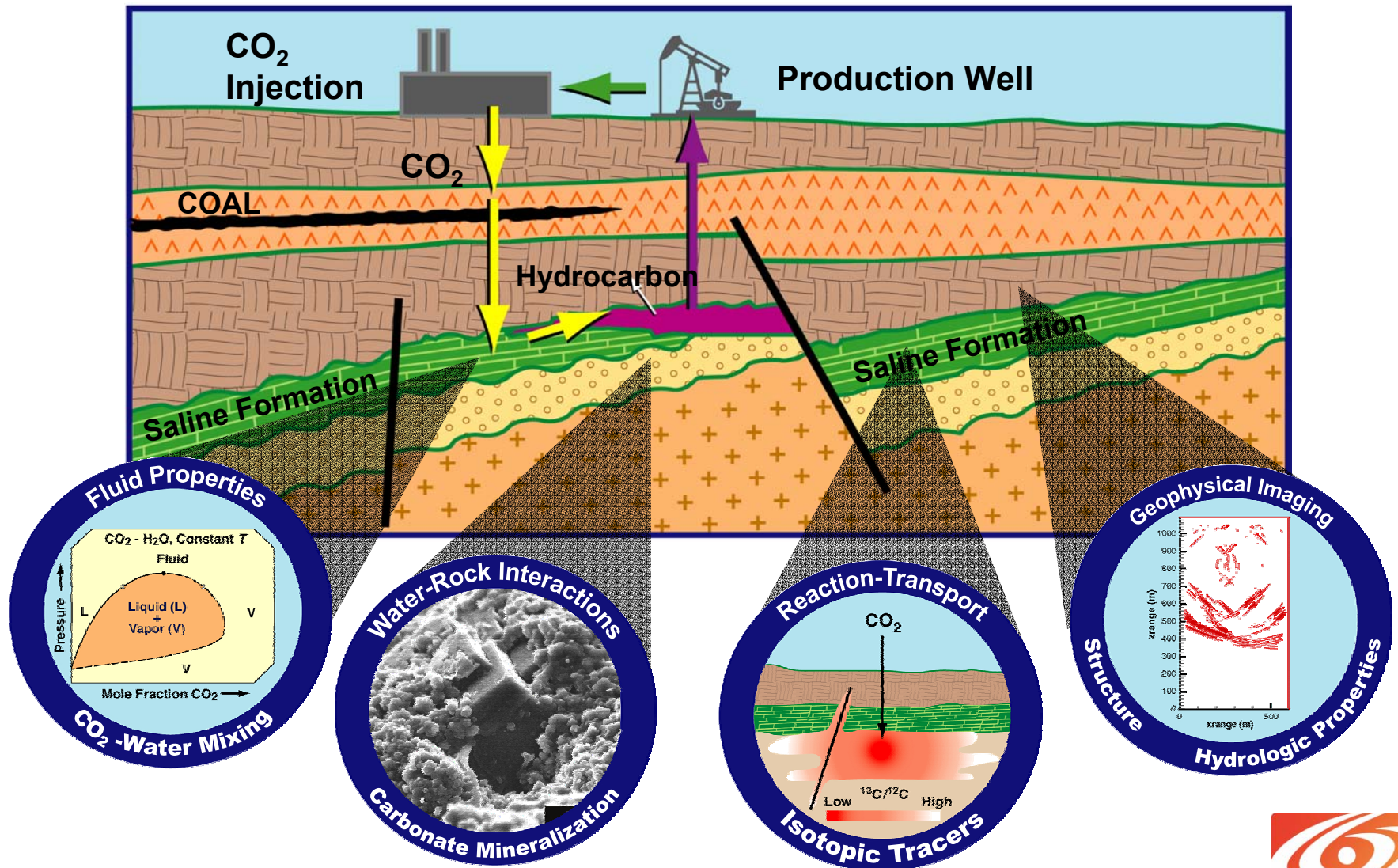
# Carbon Sequestration Roadmap

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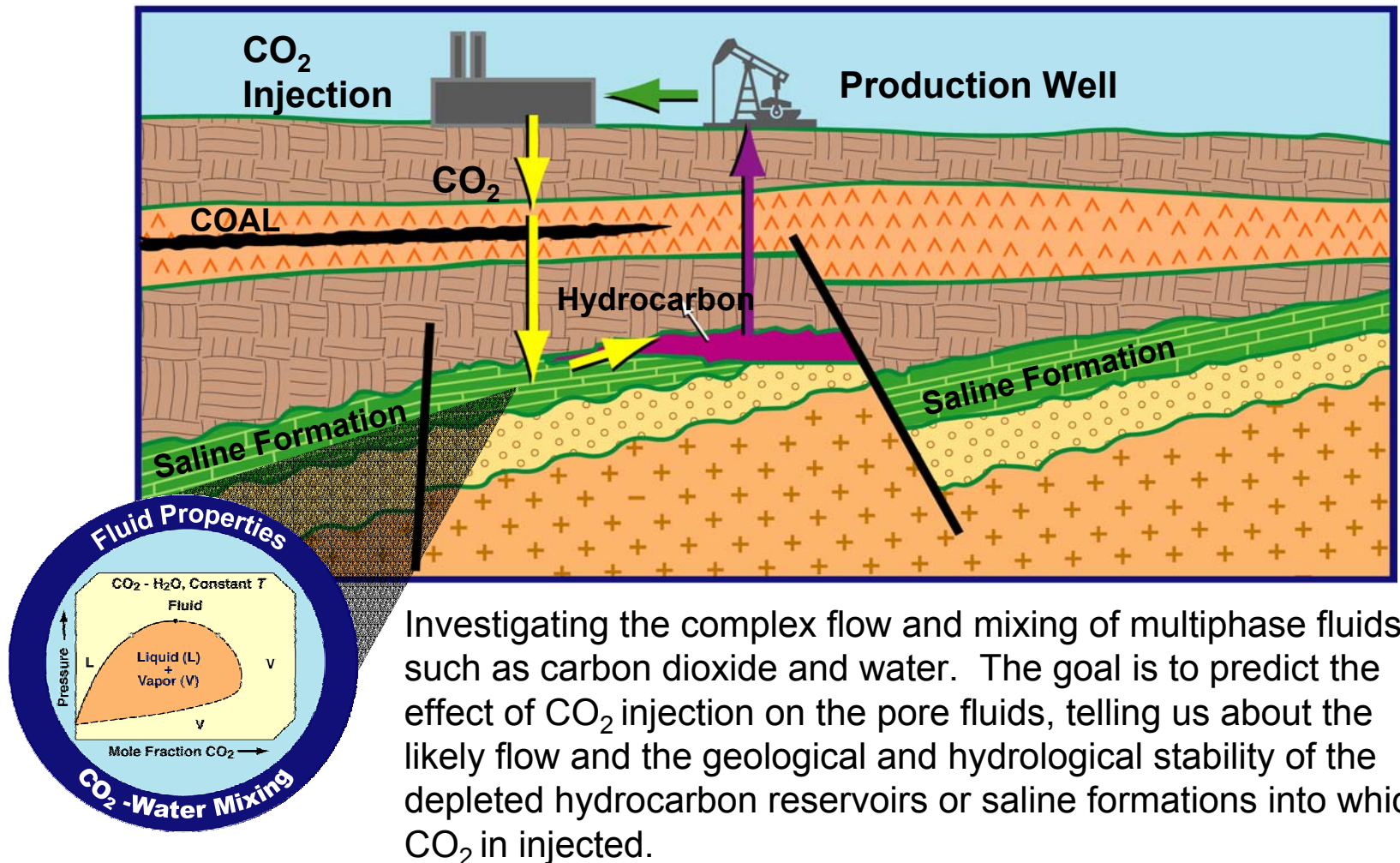
- Written by over 70 scientists with comments from a stakeholder workshop of more than 200
- The Vision: Develop the understanding to sequester a significant fraction of 1 GtC/year by 2025 and 4 GtC/year by 2050
- Provides consensus on salient research topics that would bring about the vision
- Provides a research agenda for Office of Science and Office of Fossil Energy sequestration research programs



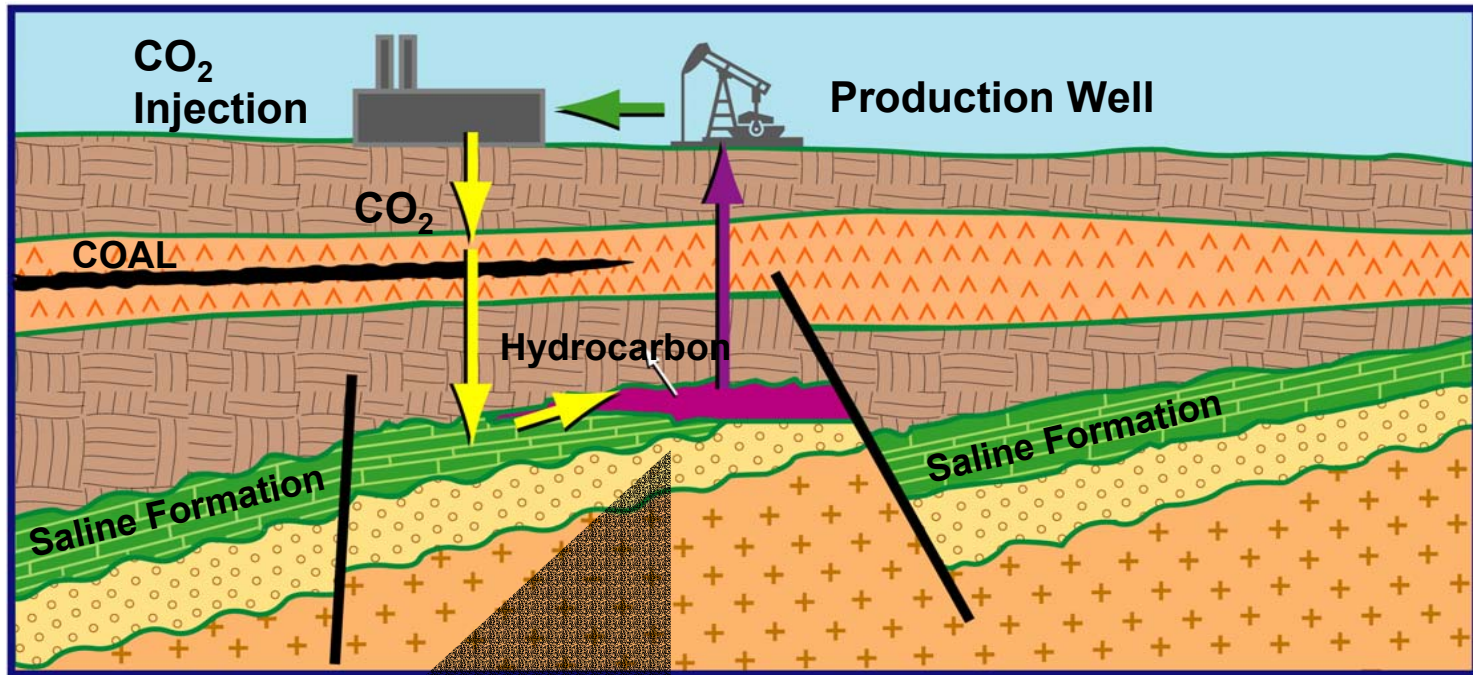
# Geological Sequestration: Depicting the injection of Carbon Dioxide Captured from a Power Plant into a Saline Formation



# Geological Sequestration: *Depicting the injection of Carbon Dioxide Captured from a Power Plant into a Saline Formation*



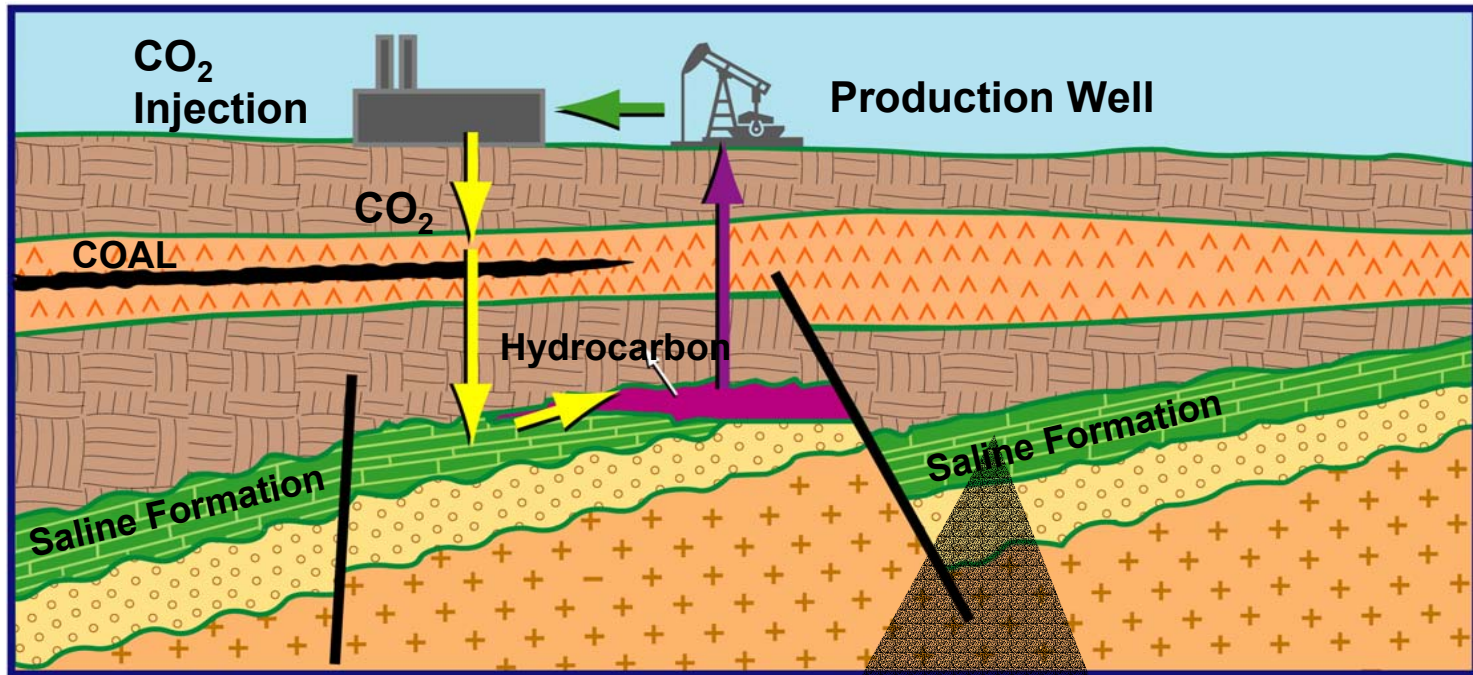
# Geological Sequestration: Depicting the injection of Carbon Dioxide Captured from a Power Plant into a Saline Formation



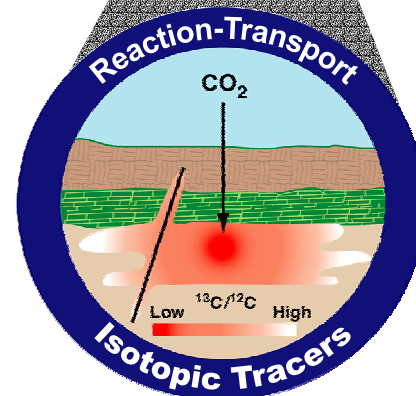
Understanding the geochemical reactions between carbon dioxide and the formation of materials. If the CO<sub>2</sub> is incorporated into minerals, it could provide permanent storage, but it could also make injection more difficult by clogging the flow pathways and thereby limiting the amount of CO<sub>2</sub> that could be injected into a formation.



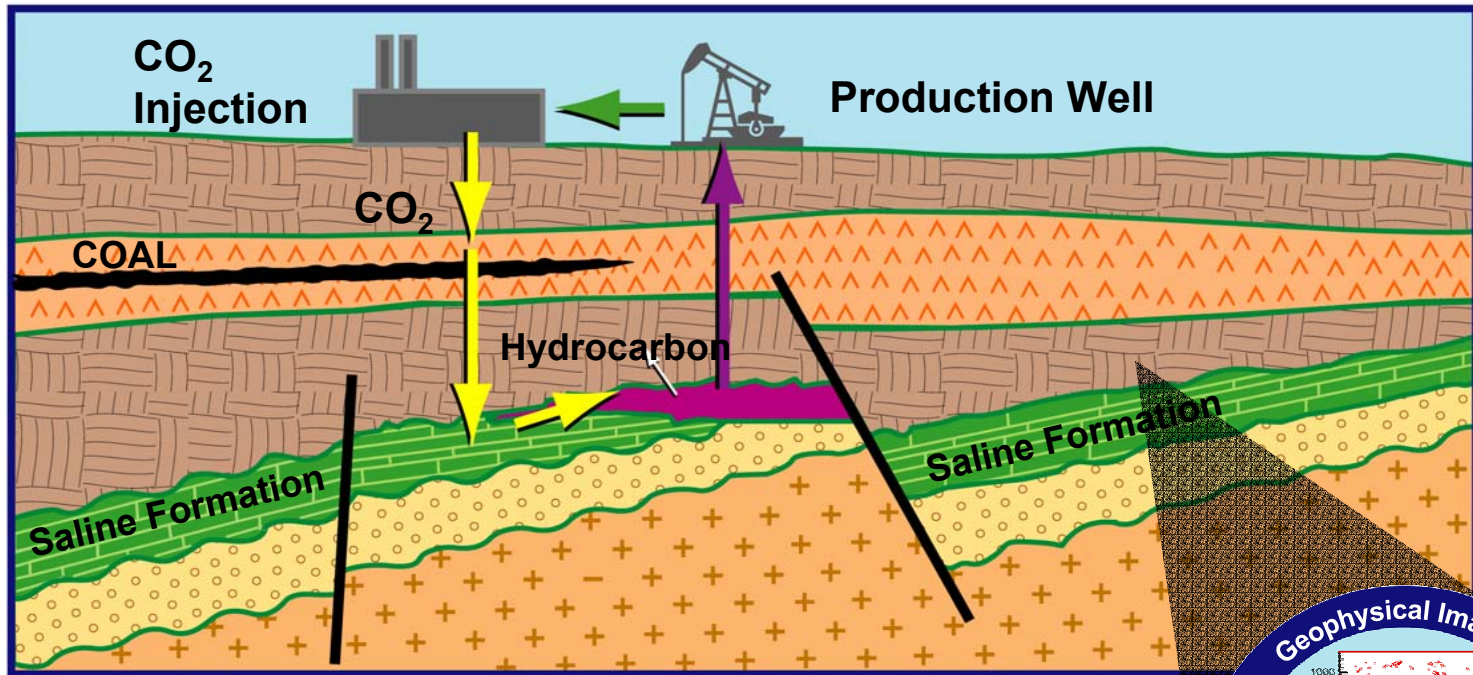
# Geological Sequestration: Depicting the injection of Carbon Dioxide Captured from a Power Plant into a Saline Formation



Improving how we track the chemical reactions and hydrologic flow occurring in formations into which CO<sub>2</sub> is injected to improve our performance assessment of storage capability. Research in this area also includes hydrological, mechanical, and chemical modeling of the physics of subsurface fluid flows.



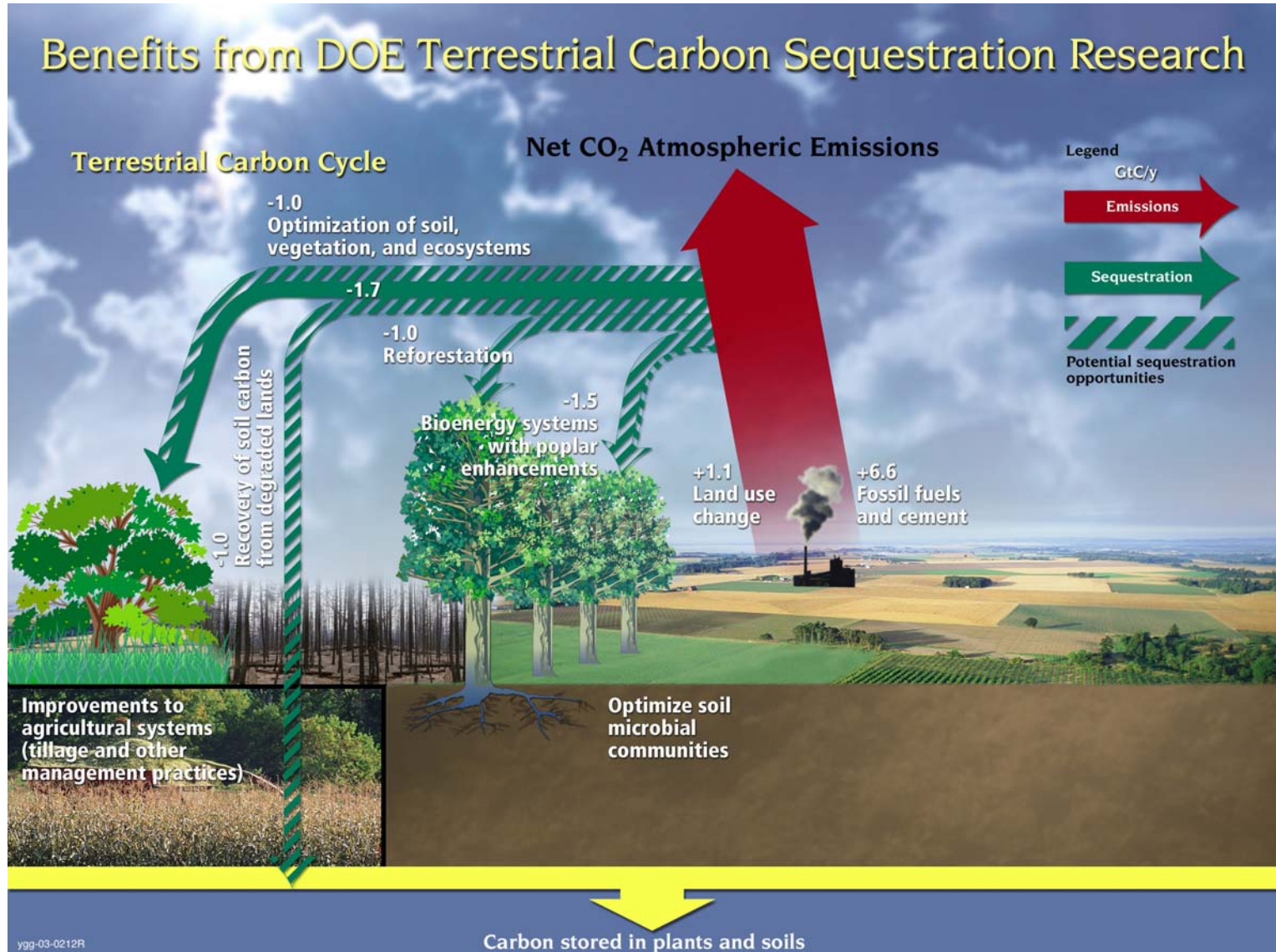
# Geological Sequestration: *Depicting the injection of Carbon Dioxide Captured from a Power Plant into a Saline Formation*



Imaging will be critical to monitor the location of the injected carbon dioxide. More needs to be known about how to detect where the carbon dioxide goes once it is injected into geologic formations and to image changes caused by the carbon dioxide to the formations that contain it.



# Terrestrial Carbon Sequestration



# *Terrestrial Carbon Sequestration*

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**The scientific issues being addressed by the terrestrial carbon sequestration research include:**

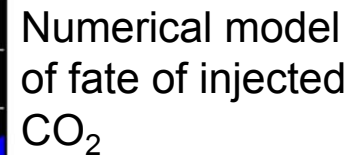
- **Understanding carbon capture and sequestration mechanisms in vegetation and soils, including how to increase the photosynthetic efficiency of plants to fix more carbon dioxide and how to promote the formation of long-lived pools of soil organic matter where the carbon will remain isolated from the atmosphere;**
- **Developing simulation models to extrapolate the understanding of carbon sequestration processes across not only different spatial and temporal scales but also across different and potentially changing environmental conditions, such as climate change;**
- **Improving understanding of both possible ancillary environmental benefits and unintended impacts of enhancing carbon sequestration and the resulting economic implications; and**
- **Developing accurate, reliable, non-invasive methods for rapid measurement of carbon sequestration in terrestrial vegetation and soils.**



## Southern Ocean Iron Fertilization



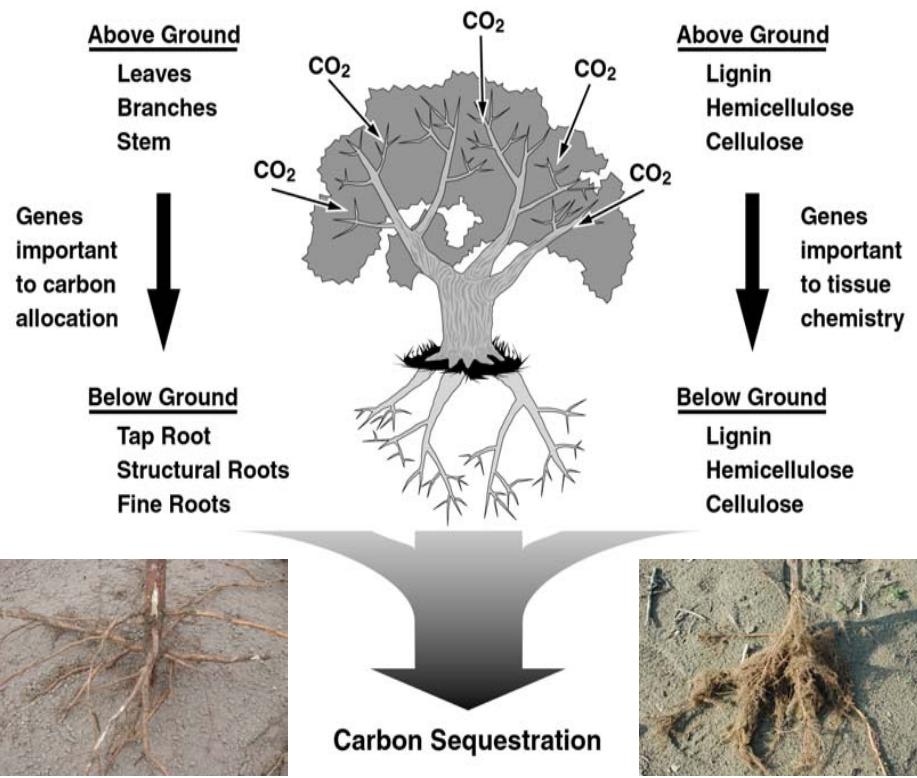
# Lawrence Livermore National Laboratory



# Genome-Enabled Discovery of Carbon Sequestration Potential in *Populus*

Sequencing the Genome of the *Populus* genus, the so-called Poplar tree (i.e. Aspen, Black Cottonwood and Hybrid Poplars)

A *Populus* tree



Greenhouse testing



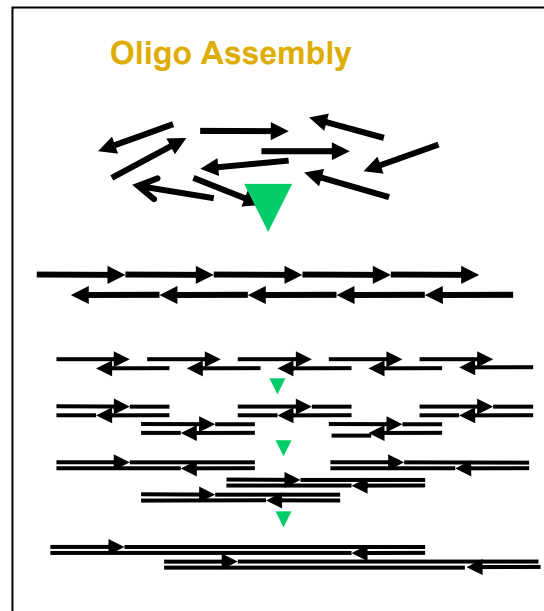
# *Advanced Biological Techniques*

## **Environmental Sampling: Microbial Communities**

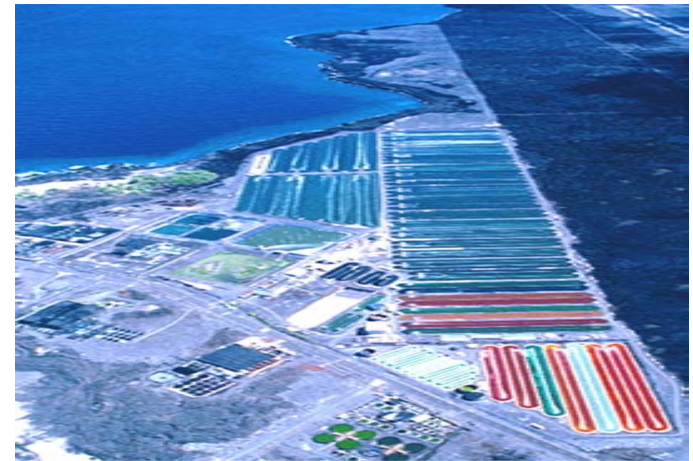


Source: Frank Dazzo, Center for Microbial Ecology, Michigan State University

## **Artificial Chromosome: Minimum Genome**



## **Applications: Algae Ponds**



Microalgae production facility of Cyanotech, Inc. in Kona, Hawaii.





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